10/501, 148
07/13/04

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I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

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Signed L C Behen

Dated 3 April 2003

Patents Form 1/77

Patents Act 1977
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1/77

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11JUL02 E732614-1 C81053
P01/7700 0.00-0216084.4

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference
EAT PAT 5

2. Patent application number
(The Patent Office will fill in this part)
11 JUL 2002 0216084.4

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
E. A. TECHNICAL SERVICES Ltd
9 RYDAL PLACE
CLITHEROE ROAD
CLITHEROE
LANCASHIRE
BB7 4JY

08306478001
Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention
COMPRESSOR WITH VARIABLE PRESSURE AND FLOW CONTROL

5. Name of your agent *(if you have one)*
Marks & Clerk
57-60 Lincolns Inn Field
London
WC2A 3LS

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

SCE 51/77
17/1/03

Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
	0200991.8	17 JAN 02
	0211603.6	21 MAY 02

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	4
Claim (s)	0
Abstract	0
Drawing (s)	~~10~~ 5

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this applicatio

Signature R W Driver Date 10 JULY 2

12. Name and daytime telephone number of person to contact in the United Kingdom RON DRIVER 01200 441492

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publicatio or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

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e) *Once you have filled in the form you must remember to sign and date it.*

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Compressor with Variable Pressure and Flow Control

Over the past few years hybrid engines have been proposed that were a combination of electric motor and a relatively small engine running at near maximum power whenever it was used. More recently there has been a move to a higher voltage electrical system, this permits engines to stop when the vehicle stops and then for the vehicle to initially move off using the electric motor.

In the present invention it is proposed to use a combination of two or more superchargers, internal combustion engine and exhaust turbine. The exhaust turbine may drive a compressor or electrical generator or both. The enabling technology to permit efficient use of this combination of components is the use of a supercharger of the type and incorporating a combination of compatible features described in application PCT/GB01/03089 and 0200991.8 and 0211603.6 and the features described in the present invention. This type of supercharger allows the internal combustion engine's airflow to be controlled. It takes a full charge of air each revolution and evacuates air not required by pushing it out through the side disc metering orifice or orifices and allows the remainder to be discharged to the engine. In this manner the supercharger can supply air from ambient pressure to maximum supercharge pressure. This type of supercharger has compression efficiency comparable with the efficiency of the compression within an engine and an ability to accurately control airflow. This combination of components eliminates the need for expensive GDI, active combustion and VVT systems and with the exception of the supercharger needs only conventional components and fuel systems although using GDI or active combustion will increase the range of power. Adding a heat exchanger to the combination enables an engine of about 500 cc capacity to replace a 1.6-litre engine but with a considerably reduced weight and fuel consumption.
With the swept volume of the internal combustion engine known, a supercharger of this type can be designed for a particular supercharger maximum pressure and with the inlet control the supercharger output pressure can be varied from ambient to maximum pressure. Under these conditions the supercharger's outlet orifice or orifices position and size are constant and no variation is necessary.
Control of air mass flow per revolution is simply achieved by exposing more or less orifice area. Having apertures in the rotor disc, casing and an outer ring most easily does this. By sliding the outer ring over the interposed casing, more or less casing apertures are exposed, when the rotor disc apertures are adjacent the exposed casing apertures air can pass through if the position of the slide allows it. By this method pressure and mass flow can be controlled.
With the impending widespread introduction of higher voltage electrical systems in vehicles, auxiliary equipment will increasingly be driven by electric motors rather than directly by the internal combustion engine. Using an electric motor and varying the machine speed relative to the engine speed could additionally control the airflow in the present invention.

In application 0200991.8 the air outlet to the engine from the supercharger was through holes or slots as they became exposed to openings in the casing. With the development of gasoline direct injection (GDI), active combustion, electric drive, regenerative braking and the supercharger described in PC PCT/GB01/03089 and 0200991.8, internal combustion engines can be further reduced in size without reducing vehicle performance. With this combination an engine of 1.6 litre can be

ambient pressure. If there were two superchargers providing air to one engine and they were controlled to provide ambient delivered pressure to the engine, the engine would then have a cylinder and inlet manifold at ambient pressure. If flow from one of the superchargers was prevented from entering the engine the volume of airflow would be halved and the cylinder and inlet manifold pressure reduced to about 38kPa. The superchargers could be driven independently of the engine and of each other or directly from the engine, if the one supplying air to the engine was independently driven by, say an electric motor, its speed could be reduced relative to the engine and thereby provide a lower delivery pressure. The supercharger not supplying air to the engine can be set to provide ambient pressure and continue to rotate and so circulate air to and from atmosphere without any meaningful pressure rise or work, or it could be disconnected.

The vanes of the rolling piston superchargers in the present invention are actuated by a reciprocating motion. This gives rise to an out of balance force. The primary out of balance forces can be balanced leaving a secondary force that can be acceptably low. However as bigger rolling piston offsets and higher speeds are designed the secondary out of balance requires balancing. This can be simply achieved by adding two linked arms to the supercharger. A consequence of providing multiple superchargers for an engine is the ability to position them so the out of balance forces can oppose each other, thus eliminating the need for linked balance arms. However installation requirements may mean that two or more superchargers cannot be placed in the optimum position for balance, making links necessary when multiple superchargers are used to reduce any out of balance couple.

The invention may be performed in various ways and some specific embodiments will now be described by way of example with reference to the accompanying diagrammatic drawings, in which:

Fig 1 shows a diagrammatic view on top of an engine with two superchargers
Fig 2 shows a diagrammatic view on the front of an engine with four superchargers
Fig 3 shows another diagrammatic view on the front of an engine with two superchargers.
Fig 4 shows a diagrammatic view on front of an engine with two superchargers
Fig 5 shows a typical cross-section of a valve for controlling the direction of airflow from one supercharger to the engine manifold.
Fig 6 shows a typical cross-section of a valve for controlling the direction of airflow from one supercharger to atmosphere.
Fig 7 shows a portion of ducting and a typical valve for controlling the direction of airflow from one supercharger to the engine manifold.
Fig 8 shows a portion of ducting and a typical valve for controlling the direction of airflow from one supercharger to atmosphere.
Fig 9 shows typical linked balancing arms.
Fig 10 shows typical linked balancing arms.

The diagrammatic views of figures 1 to 4 are only illustrative of four of a number of possible configurations. The positioning of the superchargers will be influenced by the installation requirements of the vehicle and the position and types of supercharger drive and the requirement for counter balance.
Figures 5 and 6 show a typical cross-section of a valve that can divert the airflow from a supercharger to either atmosphere or the engine inlet manifold. A number of valves known in the art can provide this function. The valves main requirements are to provide a flow with minimum aerodynamic and thermodynamic losses and to provide a seal against ingress or egress of air from the engine manifold and supercharger. The valve shown is perhaps the easiest and least costly to manufacture. The valve is circular and tubular and has substantial circumferential lengths for sealing and is required to rotate backwards and forwards by about 130 degrees.
The supercharger shown in figure 10 has two balance arms linked together that provide a balance for any secondary out of balance forces. It is convenient both from a cost point of view and because of the close proximity of the plane of the secondary out of balance, to have one arm mounted on the axis of the connecting rod centre and the other arm on the axis of the vane shaft. Fig 9 shows an alternative position for locating one end of one of the balance arms.

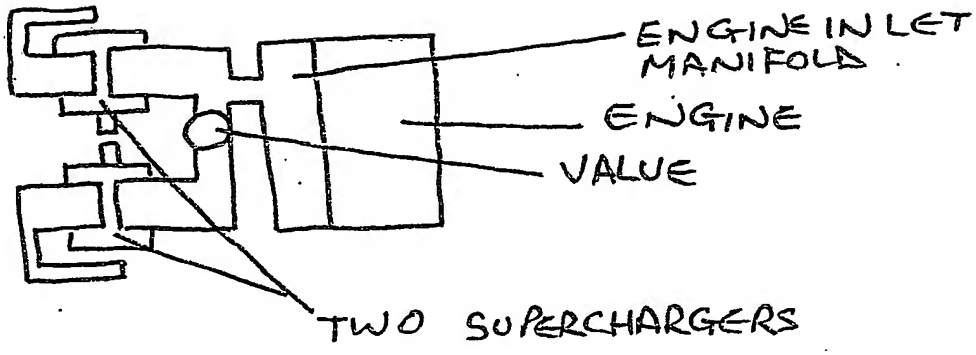
ENGINE IN LET MANIFOLD
ENGINE
VALVE
TWO SUPERCHARGERS

FIG 1

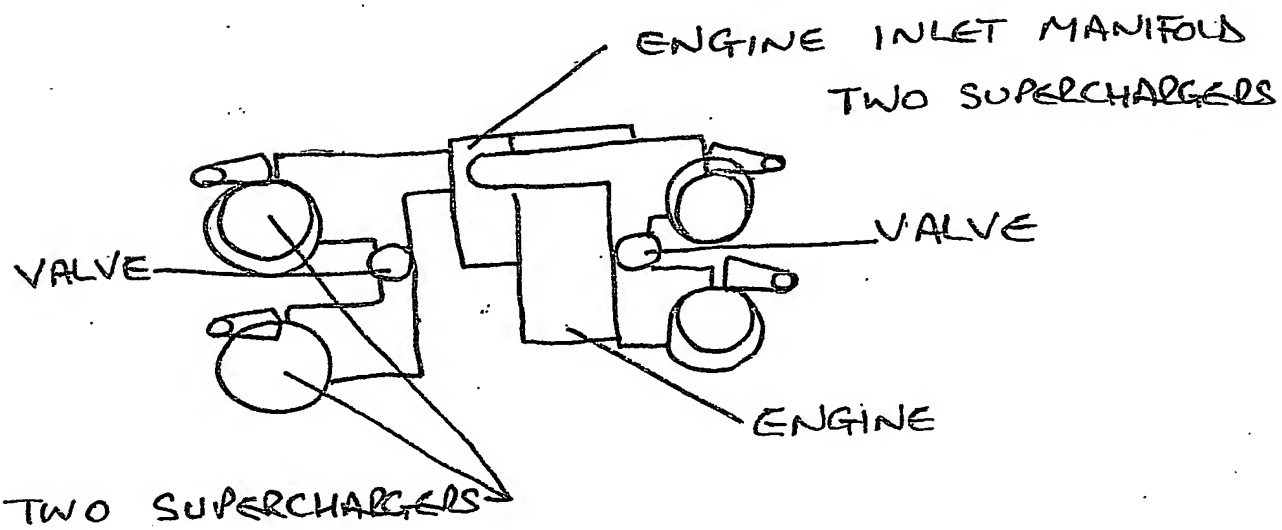
ENGINE INLET MANIFOLD
TWO SUPERCHARGERS
VALVE
VALVE
ENGINE
TWO SUPERCHARGERS

FIG 2

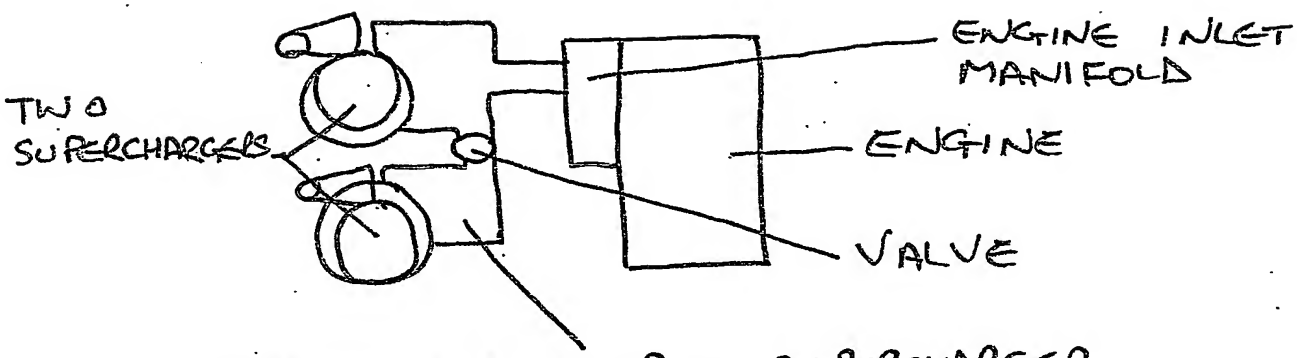
ENGINE INLET MANIFOLD
TWO SUPERCHARGERS
ENGINE
VALVE
TYPICAL OUTLET FROM SUPERCHARGER DIVERTED BY VALVE TO ATMOSPHERE AT LOW ENGINE POWER REQUIREMENT

FIG 3

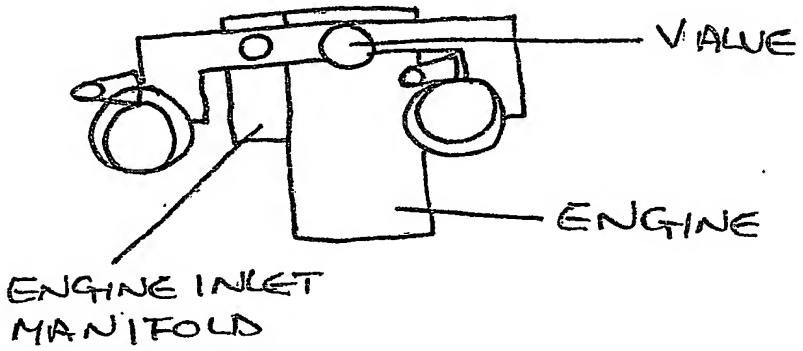
VALVE
ENGINE
ENGINE INLET MANIFOLD

FIG 4

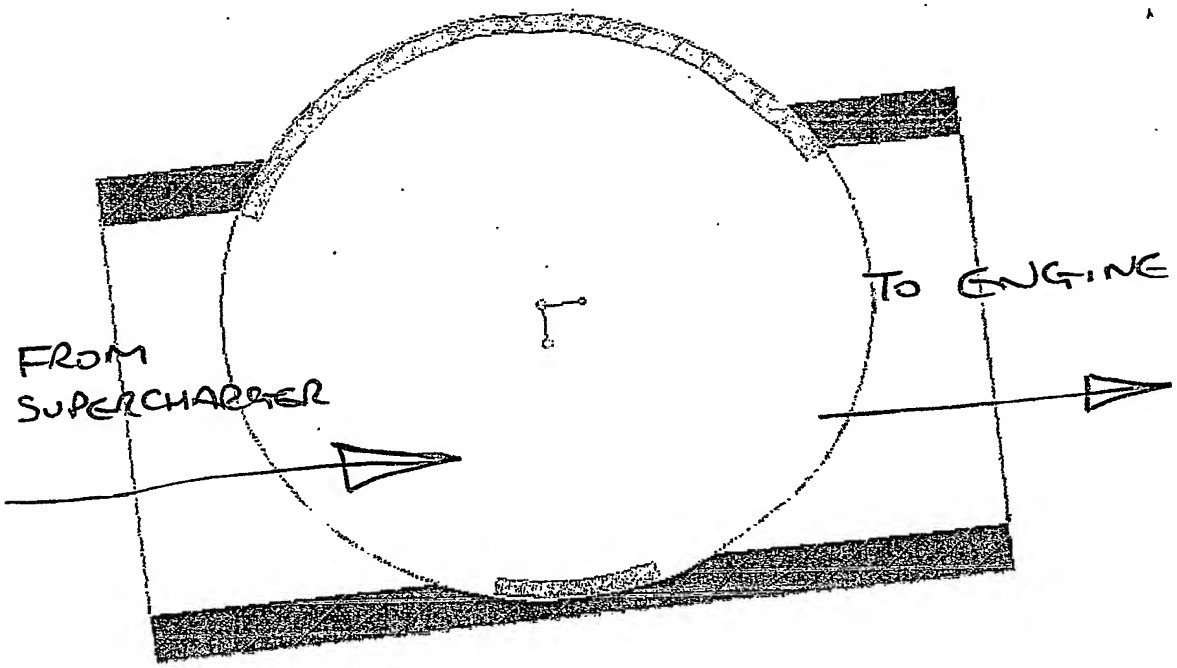
TO ENGINE
FROM
SUPERCHARGER

FIG 5

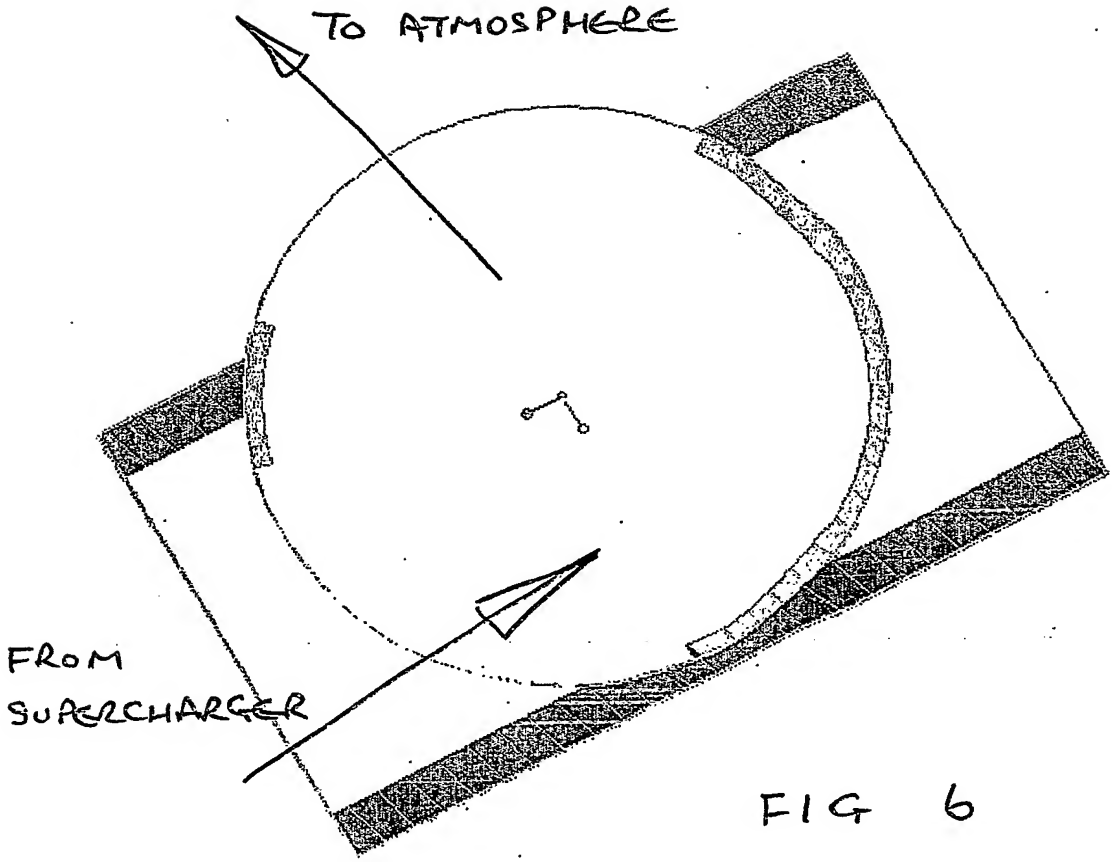
TO ATMOSPHERE
FROM
SUPERCHARGER

FIG 6

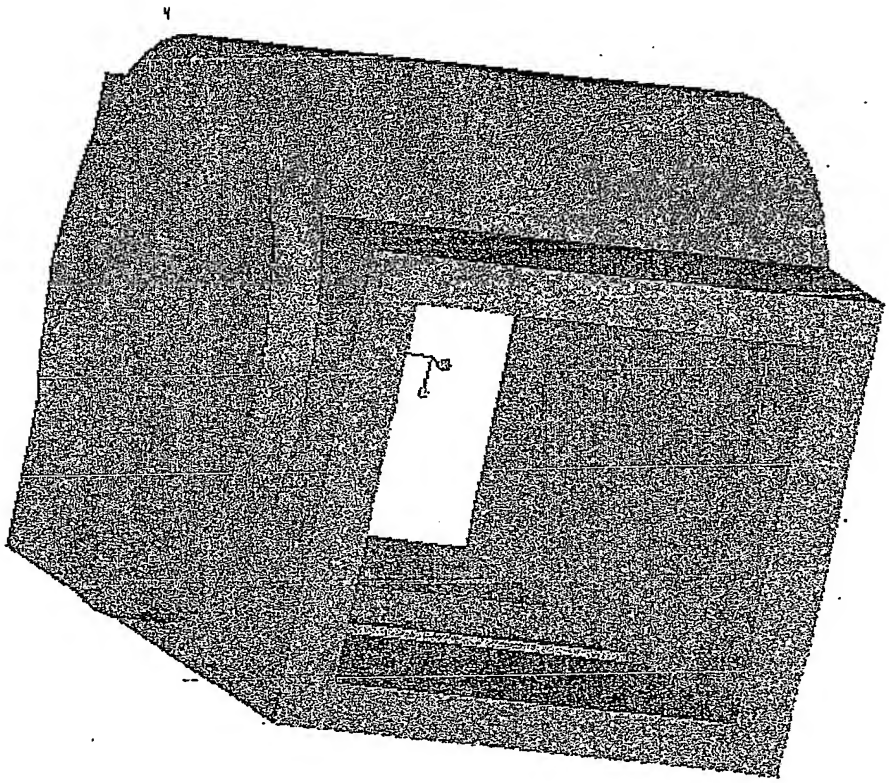

FIG 7 FROM SUPERCHARGER TO ENGINE

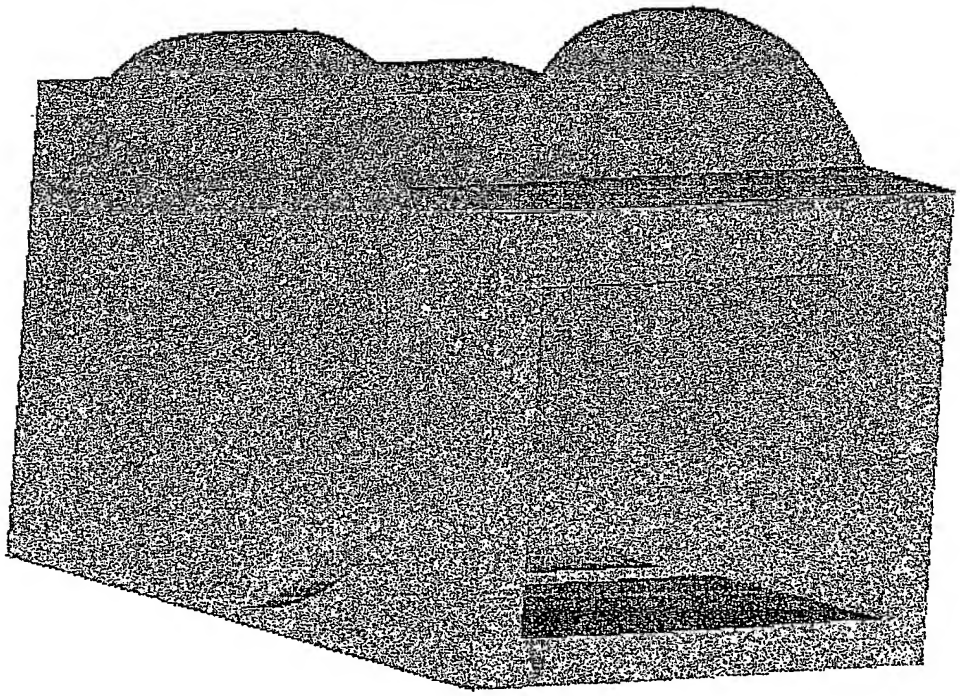

FIG 8 FROM SUPERCHARGER TO ATMOSPHERE

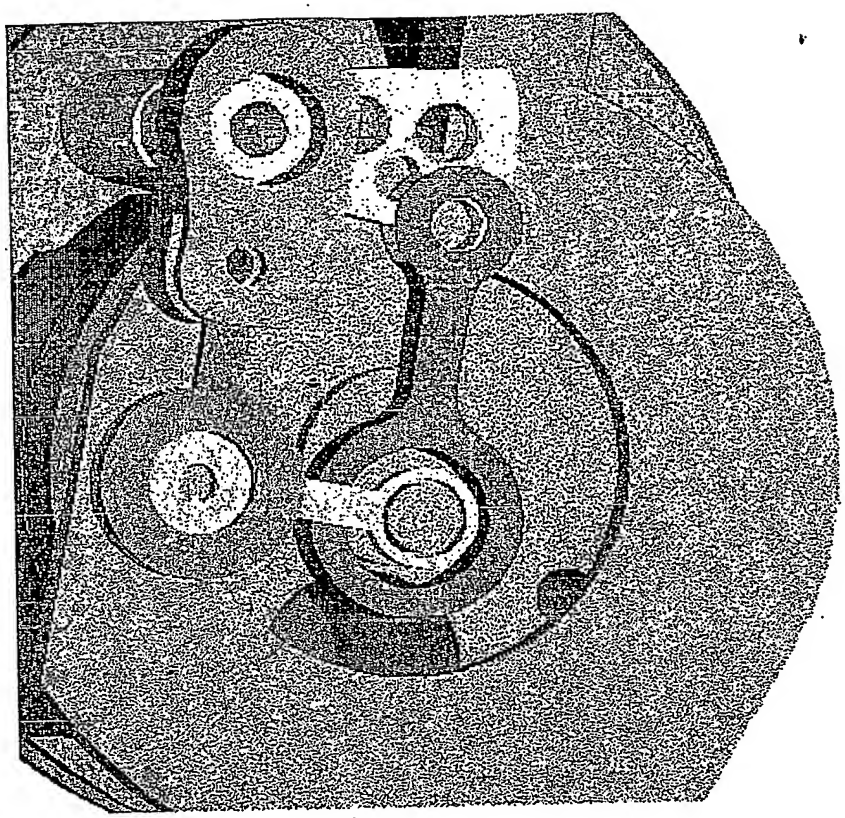

FIG 9

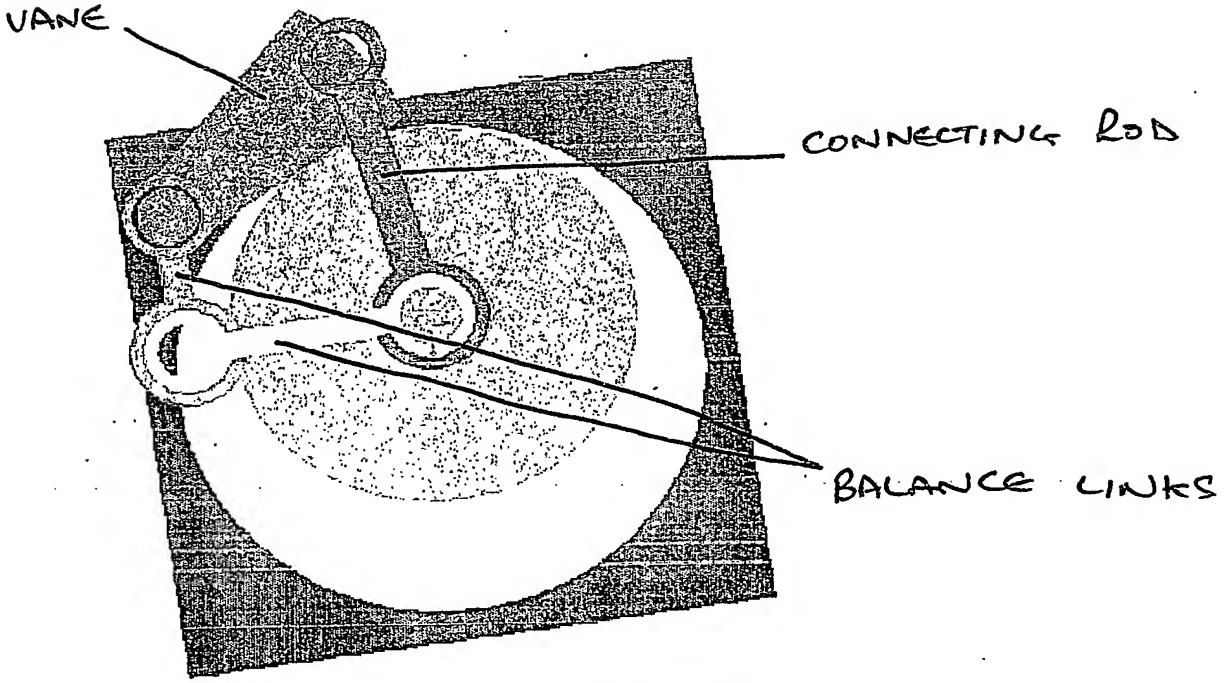

FIG 10

PCT/GB 2003/000196 J L-T